

Flexible, Reliable and Intelligent
ENERgy Delivery System (FRIENDS)
- toward more reliable power supply -

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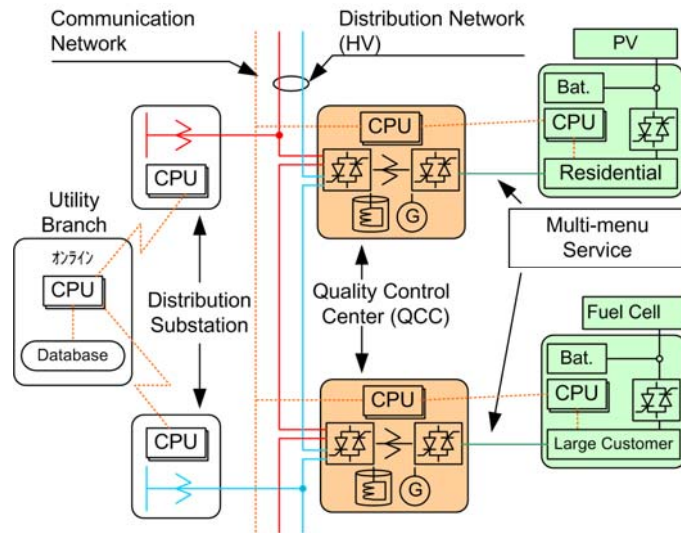


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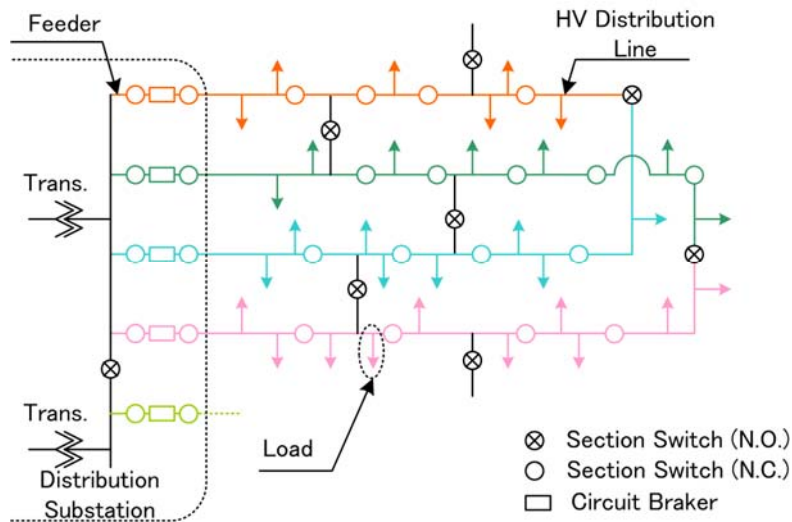
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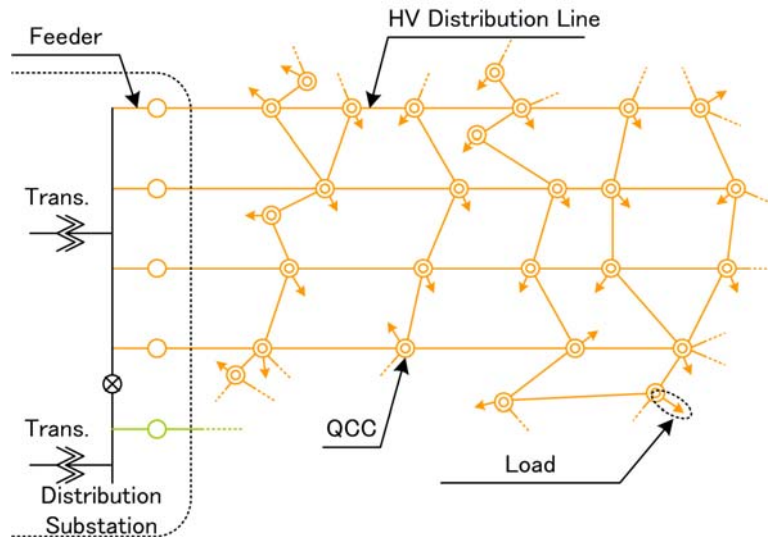
Concept of FRIENDS



Conventional Distribution Network



FRIENDS Network



Functions of FRIENDS

- **Multi-menu Supply:**
 several qualities of power are produced and supplied to the customer by QCC
- **Flexible Network Reconfiguration:**
 FRIENDS network changes its configuration flexibly and rapidly so as to mitigate the distribution losses in the normal state and eliminating the effect of fault occurred in the network
- **Compensation of Demand Side Disturbances:**
 QCC works as a buffer for the demand side disturbances (harmonics, unbalance and fluctuation in load and DG output)
- **Advanced Demand Side Management:**
 Real Time Pricing, Demand Response Program using broadband communication network

Considered Demand Area

500m	500m					
	Res	80	Res	160	Res	160
	Com	1	Com	3	Com	0
	Ind	1	Ind	0	Ind	1
	Res	80	Res	0	Res	320
	Com	0	Com	4	Com	0
	Ind	2	Ind	0	Ind	0
	Res	80	Res	160	Res	0
	Com	1	Com	2	Com	2
Ind	1	Ind	0	Ind	1	

Each customer consists of ;

High Quality Load : HQ
requiring high reliability

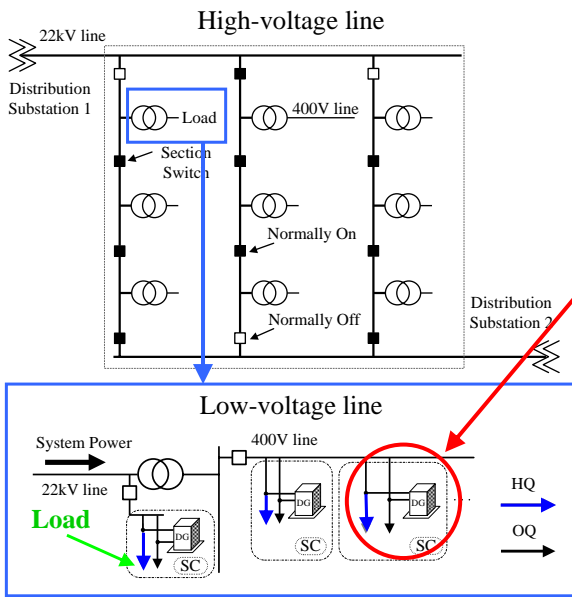
Ordinary Quality Load : OQ
requiring present reliability

Conventional Distribution System

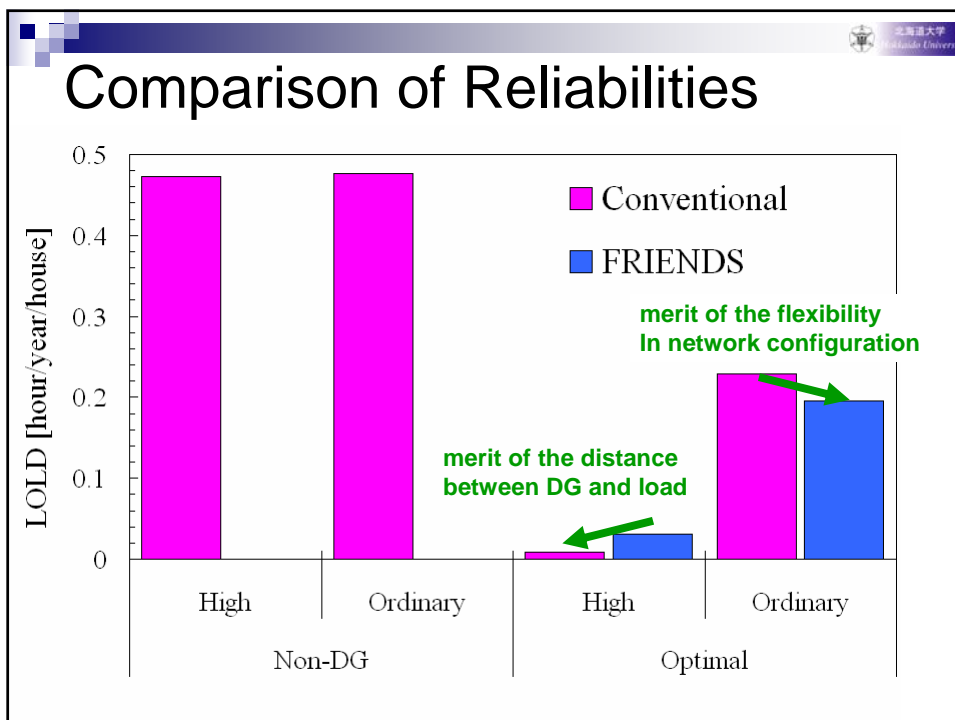
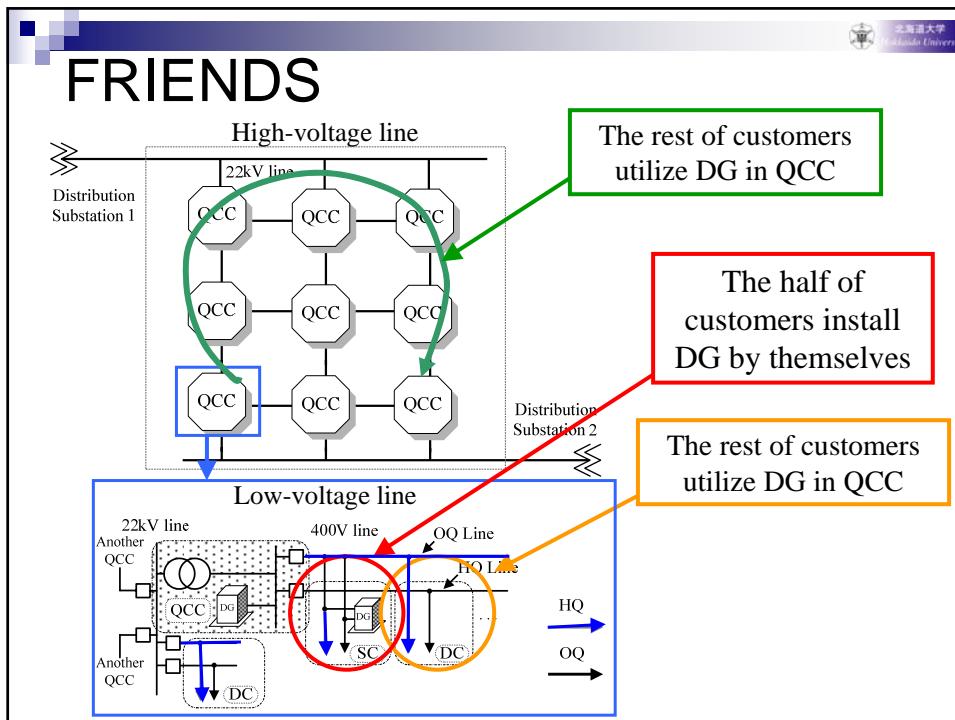
v.s.

FRIENDS

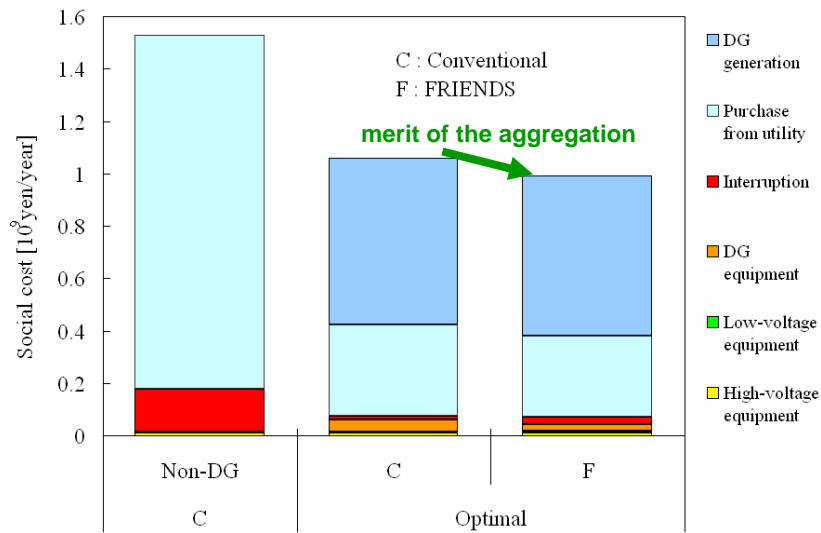
Conventional Distribution System



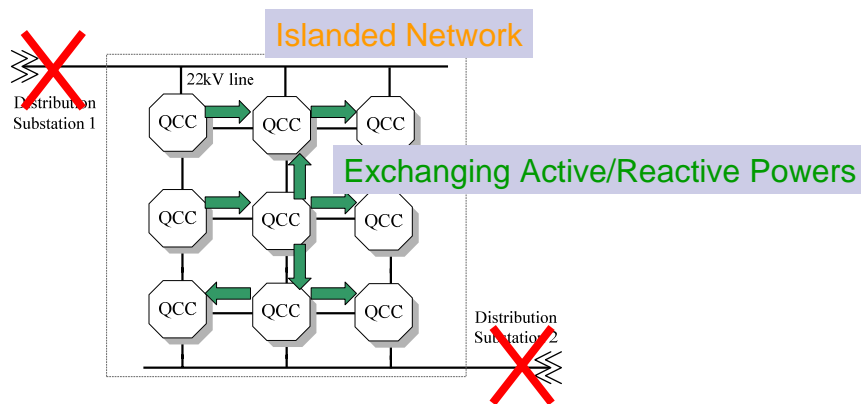
Customer installs DG to secure and enhance his supply reliability



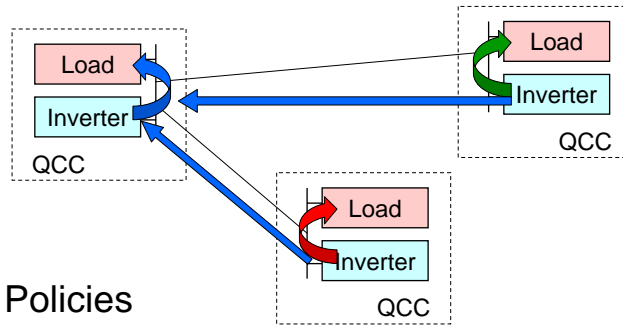
Comparison of Social Cost



Operation of FRIENDS Network Under a Faulted State



PQ Balancing by Parallelized VC Inverters

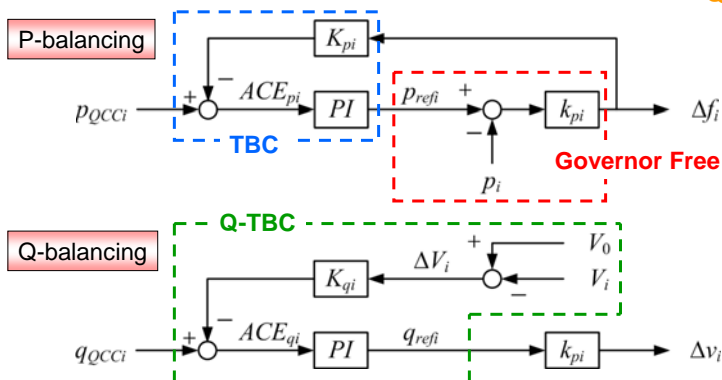
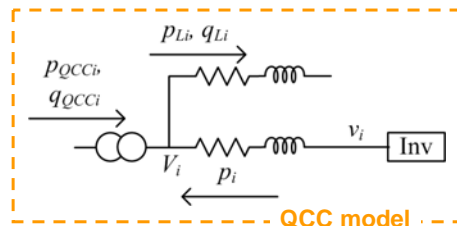


Operational Policies

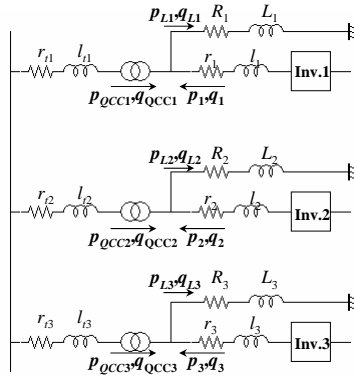
- ✓ Low frequency components in active power demand fluctuation and reactive power demand is supplied from individual inverter
- ✓ High frequency components in active power demand fluctuation is compensated by all inverters

Control System

$$v_i = \sqrt{2}(V + \Delta v_i) \sin\{2\pi(f_0 + \Delta f_i)t\}$$

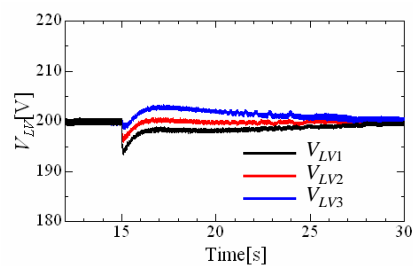
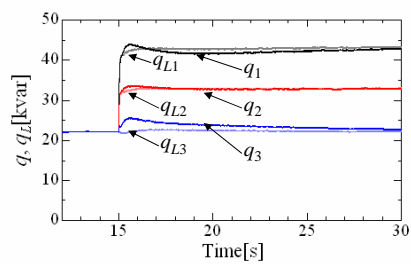
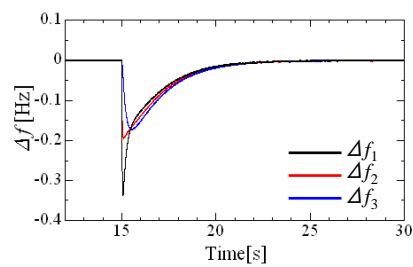
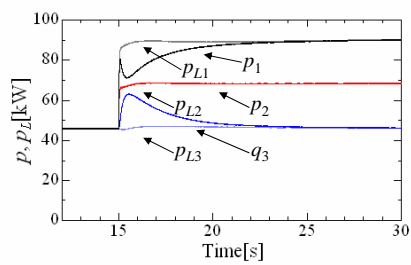


Test System Model



t		QCC#1	QCC#2	QCC#3
~10[s]	$R_i[\Omega]$	0.69984	0.69984	0.69984
	$L_i[mH]$	1.0788	1.0788	1.0788
10[s]~	$R_i[\Omega]$	0.34992	0.46656	0.69984
	$L_i[mH]$	0.5394	0.7192	1.0788

Simulation Results



Conclusion

